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(54) **ANIMAL FEED FORMULATION WHICH IS USED TO CONTROL THE FATTY ACID PROFILE IN PIG MEAT**

(57) The invention relates to a formulation comprising barley (44-55%), maize (12-18%), white wheat (3-8%), soy flour at 44 % (10-18%), sweet lupine (8-12%), calcium carbonate (0.3%), dicalcium phosphate (2.02%), sodium chloride (0.3%), DL-methionine (0.77%), L-lysine (0.368%), soy bean oil (2-4%), breeding pig porcimix 2F (0.4%) and alpha -tocopherol acetate (100-300 mg/kg.). Said animal feed is used to feed

swine for a period of up to four months prior to slaughter. In this way, the fatty acid profile, i.e. the polyunsaturated/saturated fatty acid ratio, is significantly improved and the consumer's organism is protected against LDL cholesterol and, in general, against cardiovascular diseases.

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Description

OBJECT OF THE INVENTION

[0001] This invention refers to a new formulation for pig feed, a formulation specially designed to control the profile of the fatty acids that participate in pork from pigs given this feed.

[0002] Thus, the object of the invention is to control the fatty acid composition of pork lipids, through the formulation of a feed that is given to pigs in the last few weeks/months before they are slaughtered.

[0003] This formulation means an improvement in the lipid profile, which is primarily reflected in a substantial increase in the percentage of polyunsaturated fatty acids in the total amount of fat. In addition, the amount of intramuscular fat is maintained at low levels, ranging between 2 and 3 percent.

[0004] Thus, the main advantage of the formulation proposed by the invention, with regard to fatty acids in the lipid fraction, consists of a larger proportion of polyunsaturated fatty acids compared to saturated ones.

[0005] Given the fact that, according to medical studies, a high ratio of polyunsaturated / saturated fatty acids gives the organism greater protection with respect to LDL cholesterol, and in general from cardiovascular disease, the invention is particularly applicable in the pork industry, because of the high levels of pork consumption in the Western world and the influence of the fatty acid composition of lipids in that type of meat, especially with regard to the cardiovascular health of the consumers.

BACKGROUND OF THE INVENTION

[0006] The continuous scientific and technological advances achieved in the food and agriculture industry have been offset by a significant decrease in the quality of the food that is produced, due to early maturity in livestock production, the type of feeds used for animal growth and fattening, as well as the generalized search for increasingly faster industrial manufacturing processes. All of these factors have had an impact on causing a certain deterioration in quality, as well as a gradual loss of consumer confidence, especially with regard to the fat in meat and its impact on health. It is a well-known fact that consumers have become sensitized to cardiovascular disease and the evidence that connects it to nutrition, and to the fat in meat. Thus, it is essential to achieve and maintain a better level of quality and of lipid composition, one that is not only appealing to consumers but also beneficial to their health. For this reason, improvement in the formulation of animal feed, such as the one described herein which is the object of this patent, is considered to be of the utmost interest, in order to improve the lipid profile, i.e., the proportion of polyunsaturated fatty acids to other fatty acids.

[0007] There are two major groups of lipids in meat:

1) Neutral lipids, made up mostly of triglycerides, localized in subcutaneous fat both in the dorsal adipose tissue and in fat infiltrating the muscle, and

2) Polar lipids, mainly phospholipids located in the muscular (or lean) part of the meat. Both groups of lipids are esterified with different saturated, monounsaturated and polyunsaturated fatty acids. Composition in these fatty acids depends both on endogenous synthesis and on direct deposition. It is precisely through this latter route that certain fatty acids can be accumulated in animal fat through diet (Brooks, "Fatty acid composition of pork lipids as affected by basal diet, fat source and fat level," *J. Animal Science* 33, 1971, 1224-1231). Different studies have been made about the feeding of pigs and the later checking of the fatty acid profile to verify alterations in fatty acid composition. In all of these studies, different formulations have been used whose main components are soybean meals (Lesczynski, Pikul, Easter, McKeith, McLaren, Novakofski, Bechtel and Jewell, "Characterization of lipid in loin and bacon from finishing pigs fed full-fat soybeans or tallow," *J. Animal Science* 70, 1992, 2175-2181), or a mixture with corn (Larick, Turner, Sochoenherr, Coffey and Pilkington, "Volatile compound content and fatty acid composition of pork as influenced by linoleic acid content of the diet," *J. Animal Science* 70, 1992, 1397-1403), high-oleic sunflower oil (Rhee, Davidson, Knabe, Cross, Ziprin and Rhee, "Effect of dietary high-oleic sunflower oil on pork carcass traits and fatty acid profiles of raw tissues," *Meat Science* 24, 1988, 249-260; Miller, Shackelford, Hyden and Reagan, "Determination of the alteration in fatty acid profiles, sensory characteristics and carcass traits of swine fed elevated levels of monounsaturated fats in the diet," *J. Animal Science* 68, 1990, 1624-1631) or canola (Busboom, Rule, Colin, Heald and Mazhar, "Growth, carcass characteristics and lipid composition of adipose tissue and muscle of pigs fed canola," *J. Animal Science* 69, 1991, 1101-1108). Work has also been done to incorporate antioxidants such as vitamin E and thus prevent fat oxidation (Hoving-Bolink, Eikelenboom, van Diepen, Jongbloed and Houben, "Effect of vitamin E supplementation on pork quality," *Meat Science* 49, 1998, 205-212; Pfalzgraf, Frigg and Steinhart, "α-tocopherol contents and lipid oxidation in pork muscle and adipose tissue during storage," *J. Agricultural and Food Chemistry* 43, 1995, 1339-1342; Houben, Eikelenboom and Hoving-Bolink, "Effect of dietary supplementation with vitamin E on color stability and lipid oxidation in packaged, minced pork," *Meat*

Science 48, 1998, 265-273; Zanardi, Novelli, Nanni, Ghiretti, Delbono, Dazzi, Madarena and Chizzolini, "Oxidative stability and dietary treatment with vitamin E, oleic acid and copper of fresh and cooked pork chops, " Meat Science 49, 1998, 309-320).

DESCRIPTION OF THE INVENTION

[0008] The formulation proposed by the invention constitutes a significant technological advance in this field in order to substantially improve the fatty acid profile, in other words, in order to improve the polyunsaturated/saturated fatty acid ratio, in parallel with the additional incorporation of vitamin E to protect the increase of polyunsaturated fatty acids, maintaining their integrity against oxidative processes.

[0009] Barley, corn, white wheat, soybean meal, sweet lupin, calcium carbonate, dicalcium phosphate, sodium chloride, DL-methionine, L-lysine, soy oil, 2F Porcimix for breeding pigs, and α -tocopherol acetate especially participate in the new formulation as components.

[0010] More specifically, the aforementioned components participate in the formula in the following percentages:

- Barley 45-55%
- Corn 12-18%
- White wheat 3-8%
- 44% soybean meal 10-18%
- Sweet lupin 8-12%
- Calcium carbonate 0.3%
- Dicalcium phosphate 2.02%
- Sodium chloride 0.3%
- DL-methionine 0.077%
- L-lysine 0.368%
- Soy oil 2.4%
- 2F Porcimix for breeding pigs 0.4%
- α -tocopherol (vitamin E) 100-300 mg./kg.

[0011] By using a feed with the formulation described above, and feeding the pigs for a period of up to four months prior to slaughter, the results obtained can be monitored by extracting, through physical means, any piece of meat or subcutaneous fat, and later quantifying the fatty acids through gas chromatography.

PREFERRED EMBODIMENT OF THE INVENTION

[0012] Trials have been run based on the formulation in the invention, one of which corresponds to the following example:

[0013] Starting with a litter of Large White x Landrace piglets, this litter was given a feed with the following formulation:

- 45% barley
- 17% corn
- 8% wheat
- 15% soybean meal
- 8% lupin
- 2.5 % soy oil
- 1.8% dicalcium phosphate
- 0.25% calcium carbonate
- 0.3% salt
- 0.05% L-methionine
- 0.27% L-lysine
- 0.4% Porcimix

[0014] The pigs were fed this fattening feed until they reached a live weight of 100 kg.

[0015] Once they were slaughtered, the meat was cut (24 hours post-mortem) and a sample was taken from the longissimus dorsi muscle for the analysis of intramuscular fat, and the adjacent subcutaneous tissue (visible fat).

[0016] Once both tissues were ground, and the fat was extracted, an analysis of the fatty acids was made using gas chromatography with a flame ionization detector.

[0017] The results, expressed as a percentage of the total amount of fatty acids, are shown in the table below.

Fatty Acid (%)	Intramuscular Fat	Subcut. Tissue Fat
14:0	1.8	1.4
16:0	25.7	23.8
18:0	11.4	11.7
Saturates (S)	38.9	36.9
16:1	3.2	1.7
18:1	36.8	31.6
20:1	0.45	0.45
Monounsaturates (M)	40.45	33.75
18:2	16.6	25.4
18:3	1.07	2.64
20:2	0.45	0.78
20:3	0.31	0.10
20:4	1.83	0.19
20:5	0.20	0.02
22:4	0.19	0.07
22:6	0.18	0.03
Polyunsaturates (P)	20.83	29.22
M/S Ratio	1.04	0.91
P/S Ratio	0.54	0.79

Claims

1. Feed formulation to control the fatty acid profile in pork, **characterized in that** barley, corn, wheat, soybean meal, sweet lupin, calcium carbonate, dicalcium phosphate, sodium chloride, DL-methionine, L-lysine, soy oil, 2F Porcimix for breeding pigs, and α -tocopherol acetate (vitamin E) participate in it as fundamental components.
2. Feed formulation to control the fatty acid profile in pork, according to the first claim, **characterized in that** the aforementioned components participate in the formulation in the following proportions:
 - Barley 45-55%
 - Corn 12-18%
 - White wheat 3-8%
 - 44% soybean meal 10-18%
 - Sweet lupin 8-12%
 - Calcium carbonate 0.3%
 - Dicalcium phosphate 2.02%
 - Sodium chloride 0.3%
 - DL-methionine 0.077%
 - L-lysine 0.368%
 - Soy oil 2.4%
 - 2F Porcimix for breeding pigs 0.4%
 - α -tocopherol (vitamin E) 100-300 mg./kg.

so that the pork meat obtained has a polyunsaturated fatty acid composition greater than 20% of the total fatty acids.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES 02/00290

A. CLASSIFICATION OF SUBJECT MATTER		
IPC 7 A23K 1/18, 1/16		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC 7 A23K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
CIBEPAT, EPODOC, WPI, AGRICOLA, BIOSIS		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2149513 A (FSA-KRØYER A/S) 30.03.1973, the whole document	1, 2
A	GB 2296852 A (AGRA FOOD CONSULTANTS LIMITED) 17.07.1996, the whole document	1, 2
A	BROOKS, C.C.: "Fatty acid composition of pork lipids as affected by basal diet, fat source and fat level", J. Animal Sci., vol. 33 (6) 1971, pp.: 1224-1231, ISSN 0021-8812, the whole document	1, 2
A	LESZCZYNSKI, D.E. et al.: "Characterization of lipid in loin and bacon from finishing pigs fed full-fat soybeans or tallow", J. Animal Sci., vol. 70, 1992, pp.: 2175-2181, ISSN 0021-8812, the whole document	1, 2
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
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International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	LARICK, D.K. et al.: "Volatile compound content and fatty acid composition of pork as influenced by linoleic acid content of the diet", J. Animal Sci., vol. 70, 1992, pp.: 1397-1403, ISSN 0021-8812, the whole document	1, 2
A	RHEE, K.S. et al.: "Effect of dietary high-oleic sunflower oil on pork carcass traits and fatty acid profiles of raw tissues" Meat Science, vol. 24, 1988, pp.: 249-260, the whole document	1, 2

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2149513 A	30.03.1973	DE 2240501 A GB 1356002 A DK 129497 B	08.03.1973 12.06.1974 21.10.1974
GB 2296852 A	17.07.1996	NONE	NONE